Investigation of Growth Features of Perch (Perca fluviatilis L. 1758) Population in Urkmez Dam Lake(Izmir-Turkey)

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Abstract: In this study, the growth properties of perch (*Perca fluviatilis* L. 1758) population living in Urkmez Lake were investigated. The ages of 876 fish specimen which was caught from june 1997 to May 1999 ranged from I-IV. The population was composed of 52.78 % females and 47.22 % males. The fork lengths and weights of caught samples on female and male varied from 15.97 to 32.01 cm, and 15.87 to 31.43 cm and 79.69 to 697.83 g and 80.87 to 674 g, respectively. Length-weight relationships were found as $W= 0.0082*L^{3.2716}$ for males, $W= 0.01*L^{3.2097}$ for females and $W=0.0082*L^{3.2716}$ for combined sex. Growth parameters were estimated as; $L\infty= 49{,}621$ k=0.205, to= -0835 for males, $L\infty= 49.983$, k=0,212, to= -0.838 for females and $L\infty= 51.16$, k=0,199, to= -0,865 for combined sex.

Key Words :Growth, *Perca fluviatilis*, Length-weight, Urkmez Dam Lake

Introduction

Perch **(*Perca fulivatilis)*** is existent in different regions in Turkey. Geldiay and Balık (1988) announced that this species is existent in Marmara, Black Sea basin, Sapanca and Küçük Çekmece Lakes, Lake Ladik, Samsun, Terma, Northern Anatolia Region, and in rivers between Bafra-Terma.

This species, which is mainly found in fresh water lakes in the Black Sea and Marmara Regions, has not been for in Aegean Region. However, Perca fluvatilis has been introduced to Ürkmez Dam Lake in western Turkey.

When various studies are examined, it is seen that it was examined in various aspects in different countries. For example; Karas (1996) gave information about entrance into the inventory of perches in Baltic Shores, Gutti (1993) about its growing and feeding, Zeh et al. (1989) about spawning and the growing of the eggs, of the perches in the Lake Zürich, and Wheller (1969) about its feeding; Gutti (1993) studied on about its death rate, growing and feeding , Jamet J.L (1994) on its feeding activities, Jamet, J.L., Desmolles, F. (1994) on its growing, breeding and condition. Many studies have been made on this species like the examples provided. However, it is seen that there are not many studies on this species carried out in Turkey. For example, Kır, İ., and Polat (1996-1997) studied on the feeding, Polat, N., and Kır, İ(1996-1997) on the nutiritions of it. There are also few other studies.

Need for studies on this species was felt because of reasons like there have not been many studies on it and especially it was brought into Urkmez Dam Lake subsequently. These studies were needed to monitor its evolution after the dam reservoir was fertilized with perch.

Some growing features of the perch existent in Urkmez Dam Lake were tried to be determined in this study.

Materials and Method

Ürkmez Dam Lake is located 25 kilometers away from the town Menderes in its south eastern part, in the city of İzmir in the Aegean Region in Turkey, where the study was carried out (Figure 1). This dam built for irrigation was put into operation in 1991. The study was carried out between 1997-1998.

Samples were collected with trammel nets and the net existent in the reservoir. The widths of the spaces on the inner wall were 22, 28, 32 and 36 mm and those of the outer wall were 180 and 250 mm. 180 mm outer wall were used for 22 and 28 mm inner wall and 250 mm trammel nets were used for 32 and 36 mm tor nets.

Perches were brought to the laboratory following every fishing, after explanatory information like the catching date, the type of fishing gear and the place of catching was noted. A fish ruler with a sensitivity ± 1 mm was used to measure the length of the perches and a digital scale with a sensitivity of 0.01 g was used to measure the weight of the perches.

Otoliths were evaluated for the determination of age. The otoliths of the samples measured were taken and put to envelopes and kept dry. Afterwards, the otoliths were put into a NaOH solution of 3% in order to clean the particles on them and they were kept in this solution for 15-20 minutes until they are clean. After they are cleaned they were taken out of the solution and put into an alcohol series of 30%, 40%, 50%, 60%, 70% respectively. In the end, they were dried with blotting paper and their ages were determined with binoculars on a black ground in a petri plate including with water in order to make it easy to see the age circles.

Allometric growth equation of $W=aL^b$ was used to observe the relation between length-weight (Gulland, 1969).

$W=aL^b$

Where :

W= The total body weight (g)

L= The fork length (cm)

a and b = Constants

Growth equations developed by von Bertalanffy were used in the calculation of the growth parameters of perches in the reservoir (Sparre and Venema, 1989; Beverton and Hold. 1957).

Growth equation of von Bertalanffy is as follows:

$$Lt = L\infty\left[1 - e^{-k(t-to)}\right]$$

$$Wt = W\infty\left[1 - e^{-k(t-to)}\right]^b$$

L∞ = The length of the fish, it is assumed to have in the eternity (asymptotic length), cm

L∞ = The weight of the fish, it is assumed to have in the eternity, g.

Lt = The length of the fish at the age t, cm

Wt = The weight of the fish at the age t, g.

K = Brody growth coefficient, depending on the speed of the fish to reach the asymptotic length

e = Natural logarithm base

b = Regression constant in the relation of length-weight

to = The age when the length of the fish theoretically zero.

Proportional increase in weight and proportional increase in length, and absolute length and absolute weight were calculated as they are defined by Erkoyuncu (1995).

For proportional increase in length; $OL= [L_t-(L_{t-1})]/(L_{t-1})*100$,

Proportional increase in weight; $OW= [W_t-(W_{t-1})]/(W_{t-1})*100$

For absolute growth in length

$MB= L_2 – L_1$

For absolute growth in weight;

$MB= W_2 – W_1$

Results

876 perches were caught in this study carried out in Ürkmez Dam Lak. 47.72% of the samples examined were male, 52.28% was female. Sex ratio was determined as 1:1.09. Sex ratios according to age groups are shown on Table 1.

Age Groups	Male		Female		Male + Female	
	N	%N	N	%N	N	%N
I	142	16,21	142	16,21	284	32,42
II	209	23,86	233	26,60	442	50,46
III	64	7,31	77	8,80	141	16,09
IV	3	0,34	6	0,67	9	1,03
Total	418	47,72	458	52,28	876	100

Table 1. Distribution of Age, Sex, and Percentage in the Population of *Perca fluviatilis* in Ürkmez Dam Reservoir

The individuals at the ages of I-IV among the samples takes were determined. The reason for not encountering older individuals is that 4 years had passed after this species was put into the reservoir. Considering the distribution ratio as seen in Table 1, the densest group together with females and males is the group of two-year-old individuals with a ratio of 50.46%. The sparsest group is four-year-old individuals with a ratio of 1.03%.

Average lengths according to age groups and sex were determined considering the length distributions of the samples in every age group and average lengths were calculated (Table 2).

	Age Groups			
	I	II	III	IV
	Male			
Observed	15,87	22,41	26,78	31,43
Sx	0,25	0,15	0,45	1,99
Calculated	16,12	22,46	27,61	31,78
Relative increase	15,87	6,54	4,37	4,17
	Female			
Observed	15,97	22,97	27,79	32,01
Sx	0,21	0,13	0,33	0,74
Calculated	15,95	22,39	27,62	31,85
Relative increase	15,97	7	4,82	4,22

Table 2. Average Length Distribution Values Observed and Calculated According to Age Groups and Sex in the Perch Population (cm) (Sx: standard error)

Von Bertalanffy growth equation parameters in the perch population hunted were calculated separately according to male, female and female+male individual groups (Table 3). L∞ was calculated as 49.621 at males, as 49.983 at females and as 51.160 at males and females together.

Sex	L∞ (cm)	K	to(Yıl)	Von Bertalanffy Growth equation
Male	49,621	0,205	-0,835	$Lt = 49.62[1-e^{-0,2054(t-0,8353)}]$
Female	49,983	0,212	-0,838	$Lt = 49.983[1-e^{-0,2126(t-0,8332)}]$
Male + Female	51,160	0,199	-0,865	$Lt = 51.16[1-e^{-0,1997(t-0,8653)}]$

Table 3. Von Bertalanffy Growth Parameters Calculated in the Perch Population (L∞ Eternal length, k-Growth constant, to- The age of the fish when its length was zero)

Average weights according to age groups and sex were determined considering the distributions of the fish in every age group and average weights were calculated (Table 4).

	Age Groups			
	I	II	III	IV
	Male			
Observed	80,87	225,23	411,71	674
Sx	3,82	5,35	22,8	96,94
Calculated	72,01	224,83	424,51	656,04
Relative increase	80,87	144,36	199,60	231,53
	Female			

Observed	79,69	224,94	459,94	697,83
Sx	3,29	4,43	16,89	61,18
Calculated	73,41	218,29	427,98	676,59
Relative increase	79,69	145,25	235	237,89
	Male + Female			
Observed	80,28	225,10	435,825	685,91
Sx	2,53	3,31	14,57	52,50
Calculated	73,25	214,21	418,81	663,60
Relative increase	80,28	144,82	210,73	250

Table 4. Average Weight Values Observed and Calculated According to Age Groups and Sex in the Perch Population (g).

As a result of measurements of the samples taken, Von Bertalanffy growth increase equations for female+male, male and female individuals are shown on Table 5.

Sex	W∞(g)	K	to(Yıl)	Von Bertalanffy Growth equations
Male	49,621	0,205	-0,835	$Wt = 2624{,}05[1-e^{-0{,}2054(t-0{,}8353)}]^{3{,}3379}$
Female	49,983	0,212	-0,838	$Wt = 2872{,}611[1-e^{-0{,}2126(t-0{,}8332)}]^{3{,}2097}$
Male + Female	51,160	0,199	-0,865	$Wt = 3013{,}12[1-e^{-01997(t-0{,}8653)}]^{3{,}2716}$

Table 5. Von Bertalanffy Growth Parameters Calculated in the Perch Population (L∞ Eternal weight, k-Growth constant, to- The age of the fish when its length was zero)

Regression parameters and the length-weight relation equation calculated according to male, female and male+female individuals caught in the Ürkmez Dam Reservoir in the study are shown on Table 6. Length-weight relation among all individuals caught without sex discrimination is shown on Table 2.

Sex	Growth Parameters			Length-Weight Relation Equations
	a	b	r	
Male	0,0066	3,3379	r= 0,9387	$W=0.0082\ L^{3.3379}$
Female	0,01	3,2097	r =0.9341	$W=0{,}01\ L^{3{,}2097}$
Male +Female	0,0082	3,2716	r =0,9385	$W=0{,}0082\ L^{3{,}2716}$

Table 6. Length-Weight Relation Equation and Correlation Coefficient of Perces According to Sexes.

It was determined that the difference among groups is insignificant as a result of the comparison of the values measured and calculated in the every age group for male, female and male+female individuals (Table 7).

	Age	N	Sx	Observed LF	Calculated LF	LF2-LF1	T-Test
Male	I	142	0,25	15,87	16,12	+0,15	P>0.05
	II	209	0,15	22,41	22,46	+0,05	P>0.05
	III	64	0,45	26,78	27,61	+0,83	P>0.05
	IV	3	1,99	31,43	31,78	+0,35	P>0.05
Female	I	142	0,21	15,97	15,95	-0,02	P>0.05
	II	233	0,13	22,46	22,39	-0,07	P>0.05
	III	77	0,33	27,79	27,62	-0,17	P>0.05
	IV	6	0,74	32,01	31,85	-0,16	P>0.05
Male + Female	I	284	0,16	15,93	15,96	+0,03	P>0.05
	II	442	0,1	22,44	22,34	-0,10	P>0.05
	III	141	0,27	27,33	27,57	+0,24	P>0.05
	IV	9	0,59	31,82	31,84	+0,02	P>0.05

Table 7. Importance Check of the Length Distribution Measured among *Perca fluviatilis* Samples and Calculated According to von Bertalanffy and the Difference among Them.

It is observed that considering the average length and the proportional increases in length of the *P. fluviatilis* population measured and calculated according to von Bertalanffy, measured and calculated length values are close to each other, however, proportional increases in length decreases as age increases (Table 8). Similarly, it is observed that considering the measured and calculated weights, the values are close to each other, however, proportional increases in weight decreases as age increases (Table 9).

			Observed			Calculated		
	Age	N	FL	Lt-Lt1	OL	FL	Lt-Lt1	OL
Male	I	142	15,87	_	_	16,12	_	_
	II	209	22,41	6,54	41,21	22,46	6,34	39,33
	III	64	26,78	4,32	19,28	27,61	5,15	22,93
	IV	3	31,43	4,65	17,36	31,78	4,17	15,10
Female	I	142	15,97	_	_	15,95	_	_
	II	233	22,46	6,49	40,64	22,39	6,44	40,38
	III	77	27,79	5,33	23,73	27,62	5,23	23,36
	IV	6	32,01	4,22	15,19	31,85	4,23	15,31
Male + Female	I	284	15,93	_	_	15,96	_	_
	II	442	22,44	6,51	40,87	22,34	6,38	39,97
	III	141	27,33	4,89	21,18	27,57	5,23	23,34
	IV	9	31,82	4,49	16,43	31,84	4,27	15,49

Table 8. Proportional Lengths and Proportional Increases in the Lengths of *Perca fluviatilis* Measured and Calculated According to van Bertalanffy (Lt-Lt1 = Annual Increase in Length, OL= Proportional Increase in Length)

			Observed			Calculated		
	Age	N	W	Wt-t1	OW	W	Wt-Wt1	OL
Male	I	142	80,87	_	_	72,01	_	_
	II	209	225,23	144,36	178,51	224,83	152,82	212,2
	III	64	441,71	186,48	82,79	424,51	199,68	88,81
	IV	3	674	262,29	63,70	656,04	231,68	54,54
Female	I	142	79,69	_	_	73,41	_	_
	II	233	224,94	145,25	182,27	218,29	144,88	197,36
	III	77	459,94	235	104,47	427,98	209,69	96,36
	IV	6	697,83	237,89	51,72	676,59	248,61	58,21
Male + Female	I	284	80,24	_	_	73,25	_	_
	II	442	225,10	120	114,29	214,21	140,96	192,44
	III	141	435,83	210,73	93,62	418,21	204,6	95,51
	IV	9	685,91	250,08	57,38	663,60	244,79	58,44

Table 9. Proportional Weights and Proportional Increases in the Weights of *Perca fluviatilis* Measured and Calculated According to van Bertalanffy (Lt-Lt1 = Annual Increase in Weight, OL= Proportional Increase in Weight)

The importance check of difference of the values was carried out as a result of the calculations of weights calculated and measured on all of the male, female, male+female individuals of the perch population in Ürkmez Dam Reservoir. As a result, it was determined that the difference insignificant (Table 10).

	Age Groups	N	Sx	Observed W1	Calculated W2	W2-W1	T-Test
Male	I	142	3,82	80,87	72,01	-8,86	P>0.05
	II	209	5,35	225,23	224,83	-0,4	P>0.05
	III	64	22,8	411,71	424,51	+12,8	P>0.05

	IV	3	96,94	674	656,04	-17,96	P>0.05
Female	I	142	3,29	79,69	73,41	-6,28	P>0.05
	II	233	4,43	224,94	218,29	-6,65	P>0.05
	III	77	16,89	459,94	427,98	-31,96	P>0.05
	IV	6	61,18	697,83	676,59	-21,24	P>0.05
Male + Female	I	284	2,53	80,28	73,25	-7,03	P>0.05
	II	442	3,31	225,10	214,21	-10,9	P>0.05
	III	141	14,57	435,83	418,81	-17,02	P>0.05
	IV	9	52,17	685,91	663,60	-22,31	P>0.05

Table 10. The Weight Measured on the *Perca fluviatilis* Samples and Calculated According to von Bertalanffy and the Importance Check of the Difference.

Discussion

Sex ratio changes according to species. It changes between two different populations of the same species from year to year, among age groups and according to the reaction of the species to environmental conditions. In general, male:female ratio of many species is 1:1 (Nikolski, 1980; Çetinkaya, 1989; Erkoyuncu, 1995). Çetinkaya (1989) states that the male:female ratio of perch populations may differ between 1:1 and 1:9. It was observed in this study that male:female ratio of the 876 individuals is 1:1,09. Çetinkaya (1989) stated that females are more dominant in the perch populations. Although there is not an apparent difference, females are also more dominant in this study. Treasurer (1993) revealed male:female ratios of perches in three different lakes separately. According to the study stated, male:female ratio is determined as 1:0,95 in Lake Loirston, as 1:0,81 in Lake Sand and as 1:0,89 in Lake Lowers. It is observed that they are close to the values in Lake Ürkmez.

Çetinkaya (1989) stated that perches can live until the age of 13. The oldest perches found in the Ürkmez Dam Resevoir are IV years old. The reason for this is the fact that those fish were brought to this dam reservoir subsequently and there were no individuals older than IV years of age in the hunting period.

Treasurer (1993) determined the average length value distributions of perches according to ages in his study in the lakes of Northeastern Scotland. According to this study, the average age distribution of I year of age in Lake Loriston was 5.81cm and that of II years of age was 11.81 cm. The average age distributions of the older individuals in this lake were not stated. It was stated as 6.20 cm in I-year-old age group, 12.82 cm in II-years-old age group, 18.25 cm in III-years-old age group in Lake Sand. It was stated as 8.03 cm in I-year-old group group, 15.69 cm in II-years-old age group, 20.61 cm in III-years-old age group and 24.2 cm in IV-years-old age group in Lake Lower, his another area of study. Average length in Lake Ürkmez was calculated as 15.93 cm in I-year-old age group, 22.44 cm in II-years-old age group, 27.33 cm in III-years-old age group and 27.33 cm in IV-years-old age group. Comparison of those values shows that the average length of the perches in the Lake Ürkmez is longer than the others. One of the reasons for that is the fact that as is known, water temperature affects the growth of fish. Ürkmez Dam Reservoir in Turkey is in far south of the lakes in Scotland and is in a warmer region. This may have caused the perches in Turkey to grow more. Salatenko (1955-56) stated this species as 10,75 cm at the age of I, 18.63 cm at the age of II, 24.33 cm at the age of III and 27.80 cm at the age of IV, however, as there was no explanation about the place, no comments could be made.

The average weights according ages were determined as 80.24 g. at the age of I, 225.10 g. at the age of II, 435.83 g. at the age of III and 689.91 g. at the age IV. Çelikkale, 1994 and Slastenenko, 1955-56 stated that this species weighed 45 g. at the age I, 145.5 g. at the age of II, 277.3 g. at the age of III and 522 g. at the age of IV. As it is the case in their lengths, the weights of the perches in Ürkmez Dam Reservoir are more than those values. The fact that they are in this warm region and so they grow faster and probably the fact that they do not have nutrition problems result in their fast growth.

Treasurer (1993) calculated the $L\infty$ values of the perches in Loirston, Send and Lower Lakes. At the end of his study, he calculated the $L\infty$ values of only the female individuals in Loirston as 31.6 and calculated the $L\infty$ values of only the male individuals in Lower as 29,0. He made calculations for both of the sexes in Lake Sand; found the $L\infty$ value of the male individuals as 37.9 and the $L\infty$ of the female individuals as 35.1. The $L\infty$ value of the male individuals was found to be 49.62 and the $L\infty$ value of the female individuals was found to be 49.98 in Ürkmez Dam Reservoir. The reason for the fact that $L\infty$ value of the perches in this lake is higher than the other lakes is predicted to stem from biotic and abiotic factors of the lake. Berg (1965) stated that the maximum length this species can reach can be between 30-51 cm. Wheller (1969), Geldiay and Balık (1988) stated that the maximum length of this species can reach up to 50 cm. As a result of the calculations performed, the $L\infty$ value for Ürkmez Dam lake is found to be close to the maximum value of 51 cm determined by (Berg 1965).

Considering the values obtained as a result of the study, this species can grow fast according to the conditions of the water it is in. That is why; this species can be utilized by the pisciculture of it. However, as it is a carnivorous species, pisciculture areas of it should be selected well. It should be carried out in risk free places as the fish may escape The fact that it is carnivorous may be a disadvantage for pisciculture areas but it will create an advantage for sport fishing.

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